Results of a survey carried out on Rima Hyginus under strongly oblique illumination and implication for a possible shallow dome. R. Lena[1] , J. Phillips[2] and G. Tarsoudis[3]- Geologic Lunar Research (GLR) Group. [1]Via Cartesio 144, sc. D, 00137 Rome, Italy; r.lena@sanita.it ; [2]101 Bull Street, Charleston, SC 29401, USA; thefamily90@hotmail.com, [3] Filamon 12, 68100 Alexandroupolis, Greece; gtarsoudis@gmail.com

Introduction: A magmatic origin for Rima Hyginus, reporting evidence that all of the major structural features of the Hyginus rille are the direct consequence of a shallow dike intrusion, has been recently described [1,2]. According to [1] the estimated depth to the Hyginus dike top corresponds to 580 ± 80 m and the dike width W amounts to about 163 ± 32 m with a vertical extent of the dike corresponding to 100 km

It is also likely that some of the dikes magma spread laterally, originating a laccolith, and gas pressure built up at the top of the laccolith fracturing overlying rocks [2].

Laccoliths have recently been proposed to explain various geological features such as domes or floor-fractured craters on the surface of the Moon and also Mars and Mercury [3].

As very low solar illumination angles are required to reveal the gentle slopes of lunar domes and slightly elevated soils, most of these subtle structures do not appear in the available sets of orbital images. The Lunar Reconnaissance Orbiter (LRO) WAC image of the Hyginus region (Fig. 2) shows circular pits, particularly visible on the northwest branch of Rima Hyginus. These pits formed by collapse and likely are of volcanic origin. There may have been an explosive phase associated with the collapse formation of Hyginus based on the dark annulus that surrounds it [2], (Fig.3).

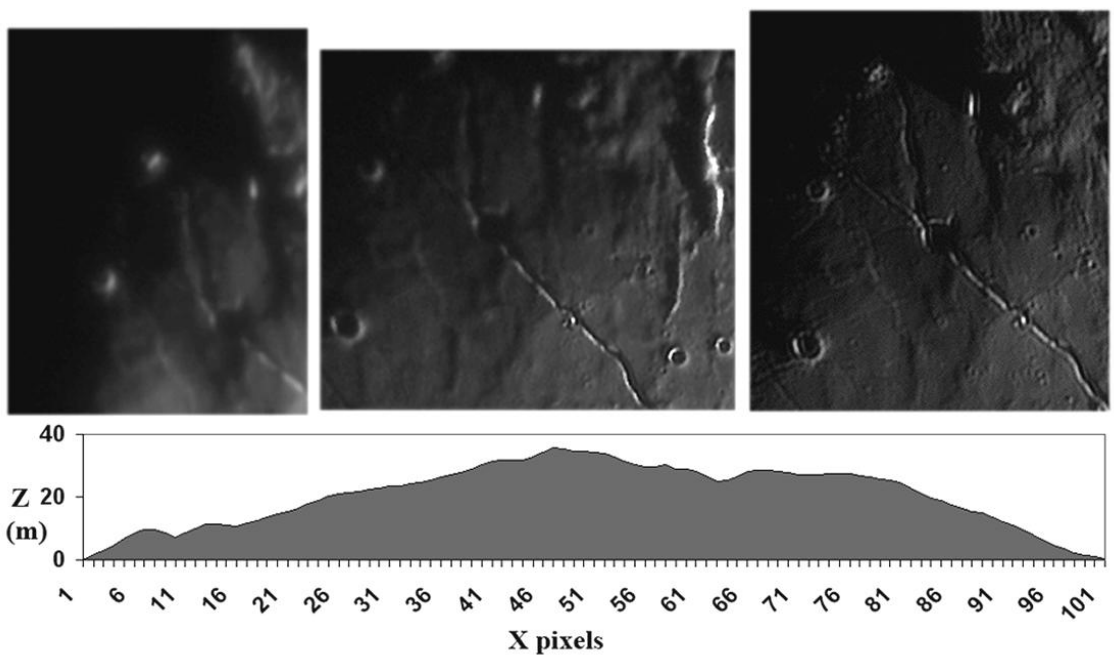

Fig. 1. Top: Telescopic images acquired (left) on January 1, 2012 at 00:54 UT with a 250 mm aperture refractor (Phillips); (middle) on July 25, 2012 at 18:00 UT with a 250 mm aperture Newtonian telescope (Tarsoudis); (right) on March 27, 2012 at 20:02 UT with a 180 mm aperture Mak-Cassegrain (Lena). Bottom: Cross-sectional profile of the shallow domical structure described in the text.

If an igneous intrusion occurred in this region, as proposed in [1-2], a slightly elevated terrain should be detected, which could be visible as an up-bowing of the soil. Hence, we have organized a survey in the region of Hyginus, with images taken under strongly oblique illumination. In this contribution we thus provide an analysis of the shallow domical structure, first discovered by J. Phillips, which is visible only under these oblique illumination conditions. In this scenario the up-bowing of the soil may be "in principle" considered as a very low dome bisected by the western branch of Rima Hyginus.

Ground-based observations: The domical object (cf. Fig. 1) is clearly detectable only with low solar angle demonstrating that Hyginus must be imaged close to the terminator. It displays a curved edge with the shadow bending around it, showing that the centre of the structure is slightly higher than the edges.

Morphometric properties: Based on the telescopic CCD images we obtained the DEMs by applying the combined photoclinometry and shape from shading method described in [4-7]. The elevation of the shallow domical structure was determined to 35 ± 5 m (Fig. 1), its diameter amounts to 36 km, resulting in a flank slope of 0.11 ± 0.02°. Assuming a parabolic dome shape the edifice volume corresponds to about 20 km^3. In the LOLA DEM, the elevation difference between the centre and the surrounding surface corresponds to about 30-40 m, which is in good agreement with our image-based photoclinometry and shape from shading analysis.

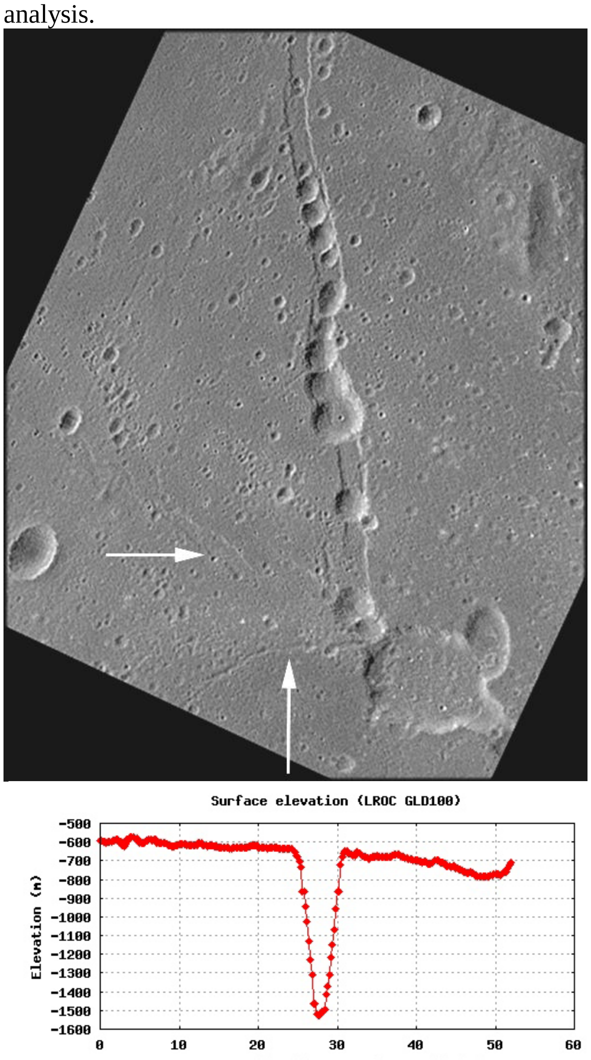

Fig. 2. Top: Section of the LROC WAC image 119808338 ME (NASA/GSFC/Arizona State University). Some linear rilles due to tensional stress, probably formed by dikes intrusion, are detectable. Bottom: Cross-sectional profile in east-west direction derived with the ACT-REACT Quick Map tool, including the depth of a small pit.
Using an enlarged section of the Y axis, the computed elevation relative to the average inclined soil corresponds to about 35 m according with the sfs measurements.

Furthermore, according to the GLD100 data [8], the structure has an inclination increasing from the west to the east.

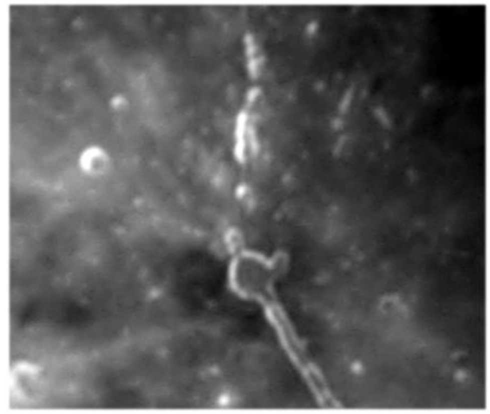

Fig. 3. Telescopic image acquired on January 6, 2012 at 04:38 UT with a 250 mm aperture refractor. The presence of the dark annulus, likely of pyroclastic origin, is detectable.

Examination of the WAC imagery identifies the presence of further linear rilles. The soil is also characterized by higher density of craterlets than those detectable in the linear rilles, circular pits and Hyginus crater (Fig. 2). All the curvilinear rilles crossing the surface of this low dome indicate structural control by subsurface geology and these features are commonly interpreted as fractural features [9] that may occur as a result of the flexural uplift. Hence, intrusive and effusive processes, including pyroclastic material, might be involved into the formation of the large dome, Hyginus and the Hyginus rille but not necessarily simultaneously; in fact the different volcanic features in the Hyginus region may even have formed completely independent of each other.

Conclusion: If an igneous intrusion occurred in this complex volcanic region, related to a magmatic body rising near the surface and spread out laterally, a slightly elevated terrain should be visible. The upbowing of the soil, we detected, may be considered as a low dome bisected by the western branch of Rima Hyginus. Based on our images, supported by the LOLA DEM and GLD100 data, we estimate its effective elevation to 35 m.

References: [1] Giguere et al. (2010) *LPSC 41st*, Abstract #1129; [2] Wilson et al. (2011) *Icarus 215*, 584-595; [3] Head et al. (2009) *Earth and Planet. Sci. Letters 285*, 251–262; [4] Wöhler et al. (2006) *Icarus 183*, 237-264; [5] Lena et al. (2007) *Planet. Space Sci. 55*, 1201-1217; [6] Wöhler & Lena (2009) *Icarus 204*, 381-398; [7] Lena et al. (2012) Lunar Domes: Properties and Fomation Processes. Springer Praxis Books, to appear; [8] Scolten et al. (2012) *J. Geophys. Res.* 117 (E00H17),doi:10.1029/2011JE003926; [9] Nichols et al. (1974) *Lun. Planet Sci. V*, 550-552.